

ESD Control in the NASA STD-8739.6

Presented By: Alvin J Boutte

NASA Workmanship Standards Program Manager



Outline

- S20.20
- NASA S20.20 history
- Overview of NASA STD-8739.6 update
- Features of ESD Controls Section 7
- Conclusion



The ANSI/ESD S20.20

ANSI/ESD S20.20-2014
Revision of ANSI/ESD S20.20-2007



ESD Association Standard

*For the Development of an
Electrostatic Discharge Control
Program for –*

*Protection of Electrical and Electronic
Parts, Assemblies and Equipment
(Excluding Electrically Initiated
Explosive Devices)*

*Electrostatic Discharge Association
7900 Turin Road, Bldg. 3
Rome, NY 13440*

*An American National Standard
Approved July 31, 2014*




ANSI/ESD S20.20-2014

*ESD Association Standard
for the Development of an Electrostatic Discharge
Control Program for –*

*Protection of Electrical and Electronic Parts, Assemblies
and Equipment (Excluding Electrically Initiated
Explosive Devices)*

Approved June 11, 2014
EOS/ESD Association, Inc.



Office of Safety and Mission Assurance



The ANSI/ESD S20.20

ANSI/ESD S20.20-2014

CAUTION NOTICE

Electrostatic Discharge Association (ESDA) standards and publications are designed to serve the public interest by eliminating misunderstandings between manufacturers and purchasers, facilitating the interchangeability and improvement of products and assisting the purchaser in selecting and obtaining the proper product for his particular needs. The existence of such standards and publications shall not in any respect preclude any member or non-member of the Association from manufacturing or selling products not conforming to such standards and publications. Nor shall the fact that a standard or publication is published by the Association preclude its voluntary use by non-members of the Association, whether the document is to be used either domestically or internationally. Recommended standards and publications are adopted by the ESDA in accordance with the ANSI Patent policy.

Interpretation of ESDA Standards: The interpretation of standards in-so-far as it may relate to a specific product or manufacturer is a proper matter for the individual company concerned and cannot be undertaken by any person acting for the ESDA. The ESDA Standards Chairman may make comments limited to an explanation or clarification of the technical language or provisions in a standard, but not related to its application to specific products and manufacturers. No other person is authorized to comment on behalf of the ESDA on any ESDA Standard.

Office of Safety and Mission Assurance



The ANSI/ESD S20.20

ANSI/ESD S20.20-2014

CAUTION NOTICE

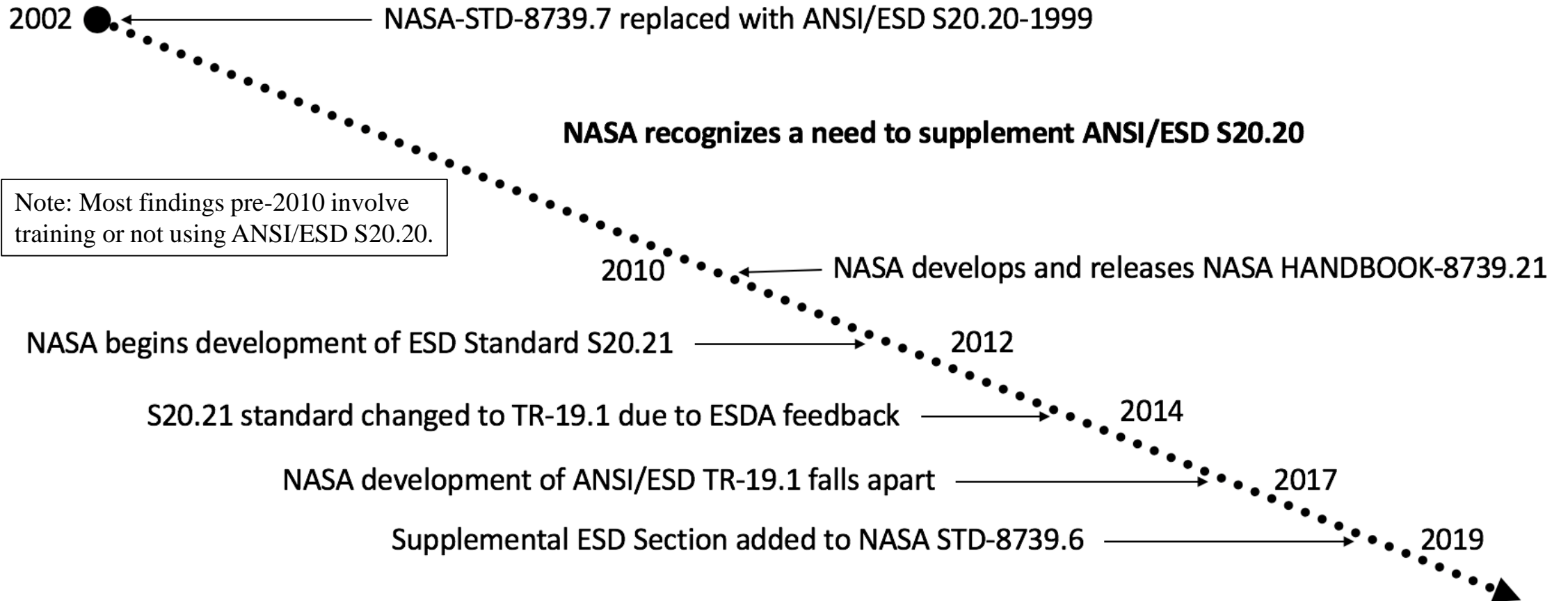
Electrostatic Discharge Association (ESDA) standards and publications are designed to serve the public interest by eliminating misunderstandings between manufacturers and purchasers, facilitating the interchangeability and improvement of products and assisting the purchaser in selecting and obtaining the proper product for his particular needs. The existence of such standards and publications shall not in any respect preclude any member or non-member of the Association from manufacturing or selling products not conforming to such standards and publications. Nor shall the fact that a standard or publication is published by the Association preclude its voluntary use by non-members of the Association, whether the document is to be used either domestically or internationally. Recommended standards and publications are adopted by the ESDA in accordance with the ANSI Patent policy.

Interpretation of ESDA Standards: The interpretation of standards in-so-far as it may relate to a specific product or manufacturer is a proper matter for the individual company concerned and cannot be undertaken by any person acting for the ESDA. The ESDA Standards Chairman may make comments limited to an explanation or clarification of the technical language or provisions in a standard, but not related to its application to specific products and manufacturers. No other person is authorized to comment on behalf of the ESDA on any ESDA Standard.

Office of Safety and Mission Assurance



NASA and the ANSI/ESD S20.20 Timeline



Note: Since 2010 the majority of ESD findings were related to confusion around or mis-interpretation of ANSI/ESD S20.20.



NASA HANDBOOK-8739.21

NASA-HDBK 8739.21

FOREWORD

This NASA-HANDBOOK is published by the National Aeronautics and Space Administration (NASA) to provide standardized guidance for implementing ANSI/ESD S20.20 requirements. This document:

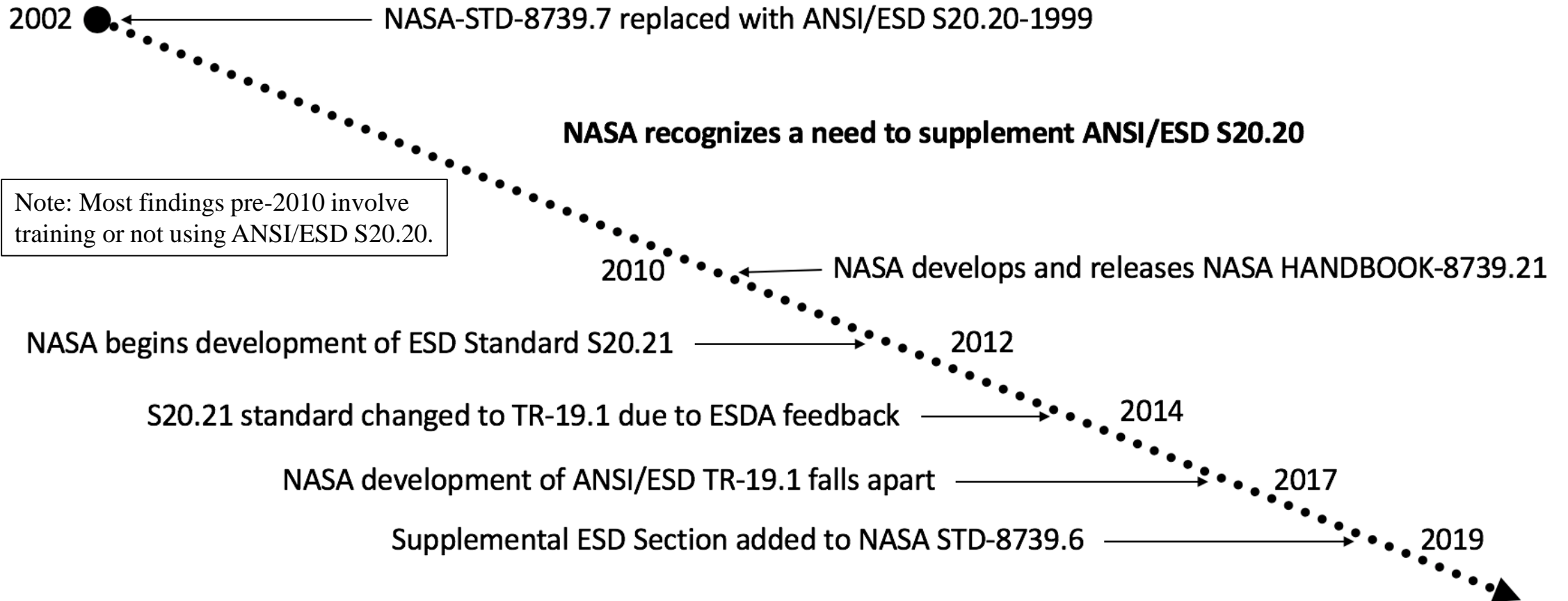
- a. Describes basic considerations necessary to ensure ESD protection in work areas to be used with ESD-sensitive items.
- b. Reinforces rigorous operator training best practice.
- c. May be used by suppliers performing work for NASA to satisfy ANSI/ESD S20.20 ESD implementation plan requirements.

NOTE: For the purpose of this document, the term “supplier” is defined as civil servants and contractors who are building and delivering ESD-sensitive hardware for NASA Projects.

Office of Safety and Mission Assurance



NASA and the ANSI/ESD S20.20 Timeline

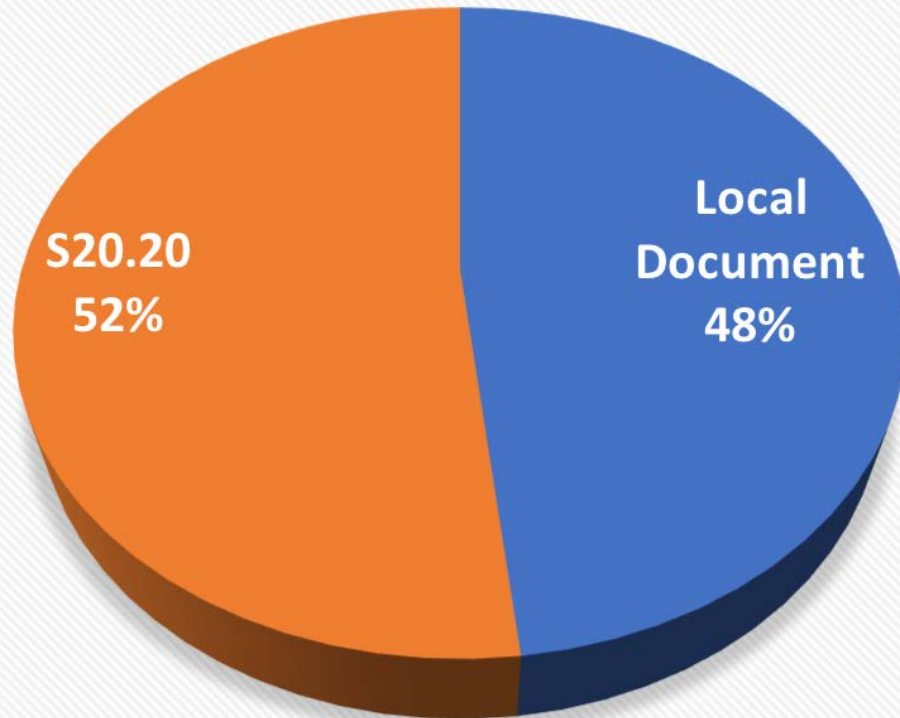


Note: Since 2010 the majority of ESD findings were related to confusion around or mis-interpretation of ANSI/ESD S20.20.

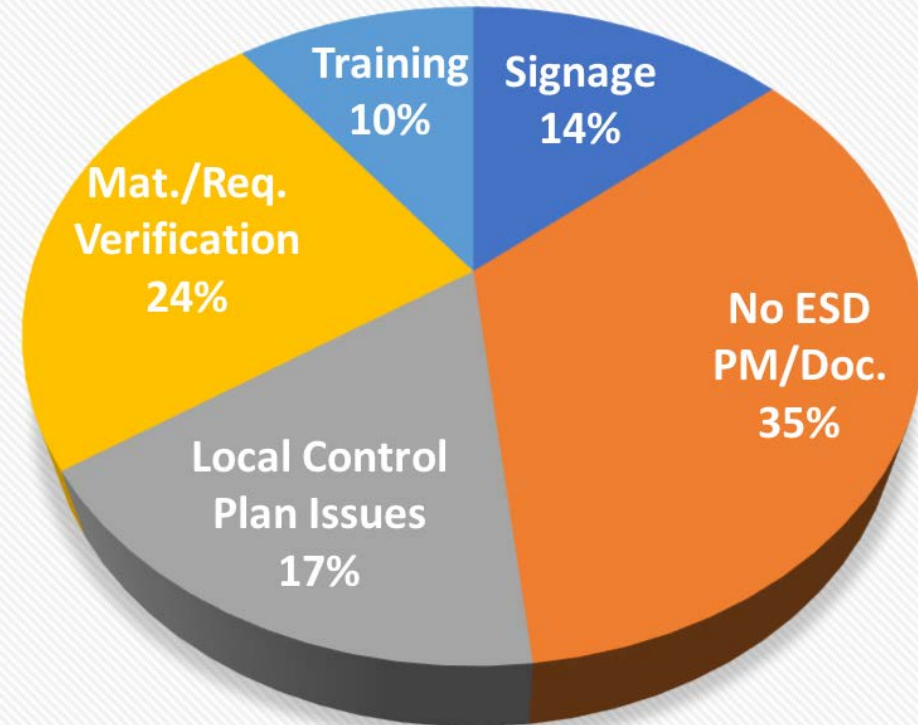


QAAR ESD Findings History

QAAR Audit Findings 2011-2018



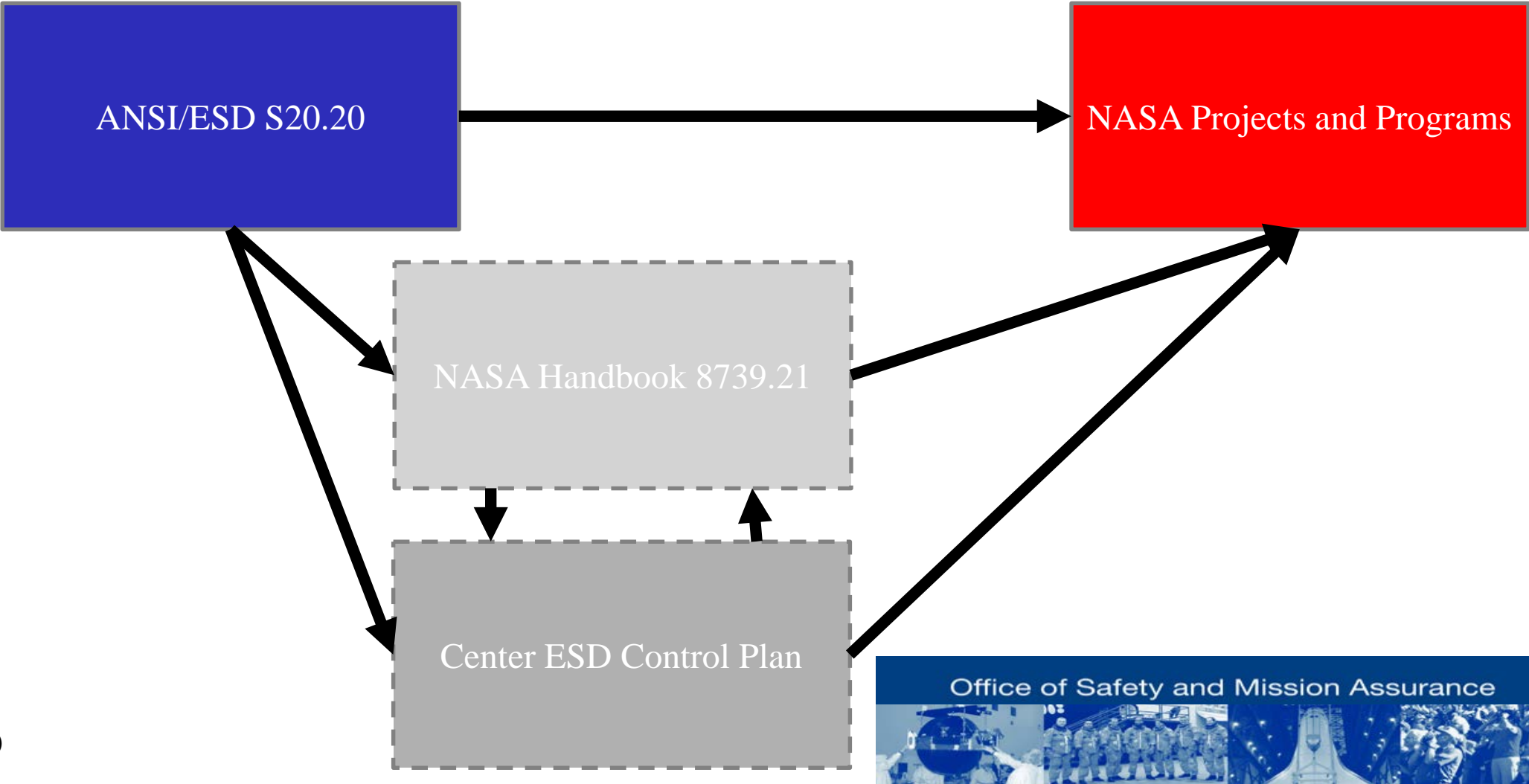
Breakdown of S20.20 Findings



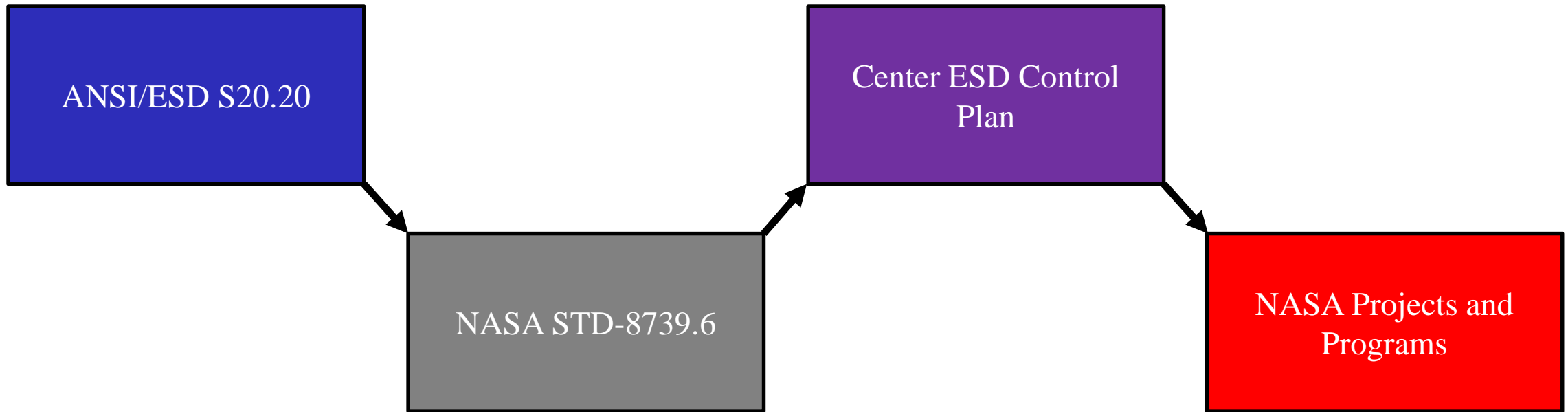
Office of Safety and Mission Assurance



Current Use of ANSI/ESD S20.20 at NASA



Future Use of ANSI/ESD S20.20 at NASA



What's new?

5. TRAINING REQUIREMENTS

This section supersedes the Section 5 requirements of NASA Standards 8739.1, 8739.4, and 8739.5.

5.1 General Training

5.1.1 This section:

- a. Establishes the training requirements for instructors.

7. ELECTROSTATIC DISCHARGE CONTROL STANDARD IMPLEMENTATION

7.1 Applicable ESD Standards

ANSI/ESD S20.20-2014

ANSI/ESD S20.20-2014 Program Plan that serves

ESD Product Qualification in accordance with ESDA procedures at NASA Centers as a part of

Requirements for Soldered Electrical and Electronic Assemblies

Space and Military Applications Electronic Hardware Addendum to IPC® J-STD-001G Requirements for Soldered Electrical and Electronic Assemblies

Requirements and Acceptance for Cable and Wire Harness Assemblies

Space Applications Electronic Hardware Addendum to IPC/WHMA-A-620C, Requirements and Acceptance for Cable and Wire Harness Assemblies

IPC® J-STD-001G

IPC® J-STD-001GS

IPC® IPC/WHMA-A-620C

IPC® IPC/WHMA-A-620C-S

Office of Safety and Mission Assurance



Appendix A requirements moved to Section 5

APPENDIX A. REQUIREMENTS FOR WORKMANSHIP STANDARDS TRAINING PROGRAMS

A.1 General

A.1.1 This section:

- a. Establishes the training requirements for workmanship operators, inspectors, and instructors.
- b. Establishes the certification requirements for workmanship operators, inspectors, and instructors to teach on behalf of a NASA Center's SMA or

5. TRAINING REQUIREMENTS

This section supersedes the Section 5 requirements of NASA Standards 8739.1, 8739.4, and 8739.5.

5.1 General Training Requirements

5.1.1 This section:

- a. Establishes the training requirements for workmanship operators, inspectors, and instructors.

Updated Voluntary Consensus Standards

Requirements for Soldered Electrical and Electronic Assemblies	IPC® J-STD-001G
Space and Military Applications Electronic Hardware Addendum to IPC® J-STD-001G Requirements for Soldered Electrical and Electronic Assemblies	IPC® J-STD-001GS
Requirements and Acceptance for Cable and Wire Harness Assemblies	IPC® IPC/WHMA-A-620C
Space Applications Electronic Hardware Addendum to IPC/WHMA-A-620C, Requirements and Acceptance for Cable and Wire Harness Assemblies	IPC® IPC/WHMA-A-620C-S



Approved Solvents and Cleaners

NASA STD 8739.4 - 2011

6.9.2 Acceptable Solvents. The following solvents are acceptable when used for cleaning connectors, hardware, and other materials and parts in cables and harnesses. Other solvents require approval of the procuring activity prior to use.

a. Denatured Ethyl alcohol, 27 CFR 21.35 Code of Federal Regulations, Title 27, Alcohol, Tobacco and Firearms, Part 21, Formulas for Denatured Alcohol and Rum, Subpart D, Specially Denatured Spirits Formulas and Authorized Uses, Formula No. 3-A.

b. Isopropyl alcohol, TT-I-735.

NASA STD 8739.1A - 2011

Table 6-1: Solvent and Cleaners

Solvents and Cleaners	Specification
Ethyl Alcohol	Per Federal Regulation 27 CFR Part 21, Subpart.35, Formula No. 3-A
Isopropyl Alcohol	TT-I-735A
Deionized Water	1 megohm-cm, minimum resistivity (See paragraph 6.9.8)
Detergent cleaners and saponifiers	(See paragraph 6.9.9)

Approved Solvents and Cleaners

NASA STD 8739.6 - 2016

6.7 Solvents and Cleaning

6.7.1 Deionized water and isopropyl alcohol are considered standard solvents and do not require approval prior to use for cleaning printed circuit boards, printed wiring assemblies, or soldered contacts, terminals, or splices. All other solvents require prior approval from the applicable NASA Technical Authority.

NASA STD 8739.6 - 2019

6.7 Solvents and Cleaning

6.7.1 Deionized water, denatured ethyl alcohol, and isopropyl alcohol are considered standard solvents and do not require approval prior to use for cleaning printed circuit boards, printed wiring assemblies, soldered contacts, terminals, cable harness assemblies, or splices. All other cleaning processes require prior approval from the applicable NASA Technical Authority.



Addition of Section 7 ESD Control Requirements

7. ELECTROSTATIC DISCHARGE CONTROL STANDARD IMPLEMENTATION

7.1 Applicable ESD Standard

ANSI/ESD S20.20-2014 contains the baseline requirements for ESD control. ANSI/ESD S20.20-2014 requires the development of an ESD Control Program Plan that serves as the principle document for ESD control. ESD Product Qualification test data generate the ESD Control Program Plan in accordance with ESDA product qualification requirements. NASA Centers as a part of their ESD Product Qualification

Table 3. Summary of the ESD Control Verification Values

#	ESD Control	Verification Values (Alternate Test Methods)	Recommended Verification Intervals				
			Continuous	Daily	Monthly	Biannual	Annual
1	Work Surface Resistance	10^6 to $< 10^9\Omega$ (ANSI/ESD S4.1)			×		
2	Work Surface Grounding	10^6 to $< 10^9\Omega$ (ANSI/ESD S4.1)			×		
3	Protective Floor Resistance	If Dissipative: 10^6 to $< 10^9\Omega$ (ANSI/ESD S7.1) If Conductive: $< 10^6\Omega$ (ANSI/ESD S7.1)			×		
4	Protective Floor Grounding	If Dissipative: 10^6 to $< 10^9\Omega$ (ANSI/ESD S7.1) If Conductive: $< 1\Omega$ (ANSI/ESD S7.1)			×		

Office of Safety and Mission Assurance



Clarified Technical Requirements

7.2.4.1 Work Surfaces

Work surfaces in EPAs are those that will be used to physically host the ESDS item and may be used as a ground path for items that can be grounded but do not contain a Groundable Point (Gp). The work surface shall meet the following requirements:

7.2.4.1.1 The resistance of work surface where ESDS items are handled shall be in the dissipative range, from 10^6 to $<10^9\Omega$. See Table 3, #1 for alternative verification methods.

Note: This should be measured between two points 10" apart on the Work Surface and 2" from the edge in the commonly used area.

7.2.4.1.2 The resistance from the center of the work surface to the common point ground shall be 10^6 to $<10^9\Omega$. See Table 3, #2 for alternative verification methods.

7.2.4.1.3 When conductive surfaces must be used as an ESD work surface, control methods to prevent an ESD event shall be documented by the ESD Control Program Plan.

Note: Conductive surfaces, grounded or ungrounded, can enable ESD events to occur.



Clarified Technical Requirements

7.2.4.1 Work Surfaces

Work surfaces in EPAs are those that will be used to physically host the ESDS item and may be used as a ground path for items that can be grounded but do not contain a Groundable Point (Gp). The work surface shall meet the following requirements:

7.2.4.1.1 The resistance of work surface where ESDS items are handled shall be in the dissipative range, from 10^6 to $<10^9\Omega$. See Table 3, #1 for alternative verification methods.

Note: This should be measured between two points 10" apart on the Work Surface and 2" from the edge in the commonly used area.

7.2.4.1.2 The resistance from the center of the work surface to the common point ground shall be 10^6 to $<10^9\Omega$. See Table 3, #2 for alternative verification methods.

7.2.4.1.3 When conductive surfaces must be used as an ESD work surface, control methods to prevent an ESD event shall be documented by the ESD Control Program Plan.

Note: Conductive surfaces, grounded or ungrounded, can enable ESD events to occur.



Clarified Technical Requirements

7.2.4.1 Work Surfaces

Work surfaces in EPAs are those that will be used to physically host the ESDS item and may be used as a ground path for items that can be grounded but do not contain a Groundable Point (Gp). The work surface shall meet the following requirements:

7.2.4.1.1 The resistance of work surface where ESDS items are handled shall be in the dissipative range, from 10^6 to $<10^9\Omega$. See Table 3, #1 for alternative verification methods.

Note: This should be measured between two points 10" apart on the Work Surface and 2" from the edge in the commonly used area.

7.2.4.1.2 The resistance from the center of the work surface to the common point ground shall be 10^6 to $<10^9\Omega$. See Table 3, #2 for alternative verification methods.

7.2.4.1.3 When conductive surfaces must be used as an ESD work surface, control methods to prevent an ESD event shall be documented by the ESD Control Program Plan.

Note: Conductive surfaces, grounded or ungrounded, can enable ESD events to occur.



Clarified Technical Requirements

7.2.4.1 Work Surfaces

Work surfaces in EPAs are those that will be used to physically host the ESDS item and may be used as a ground path for items that can be grounded but do not contain a Groundable Point (Gp). The work surface shall meet the following requirements:

7.2.4.1.1 The resistance of work surface where ESDS items are handled shall be in the dissipative range, from 10^6 to $<10^9\Omega$. See Table 3, #1 for alternative verification methods.

Note: This should be measured between two points 10" apart on the Work Surface and 2" from the edge in the commonly used area.

7.2.4.1.2 The resistance from the center of the work surface to the common point ground shall be 10^6 to $<10^9\Omega$. See Table 3, #2 for alternative verification methods.

7.2.4.1.3 When conductive surfaces must be used as an ESD work surface, control methods to prevent an ESD event shall be documented by the ESD Control Program Plan.

Note: Conductive surfaces, grounded or ungrounded, can enable ESD events to occur.



Clarified Technical Requirements

7.2.4.1 Work Surfaces

Work surfaces in EPAs are those that will be used to physically host the ESDS item and may be used as a ground path for items that can be grounded but do not contain a Groundable Point (Gp). The work surface shall meet the following requirements:

7.2.4.1.1 The resistance of work surface where ESDS items are handled shall be in the dissipative range, from 10^6 to $<10^9\Omega$. See Table 3, #1 for alternative verification methods.

Note: This should be measured between two points 10" apart on the Work Surface and 2" from the edge in the commonly used area.

7.2.4.1.2 The resistance from the center of the work surface to the common point ground shall be 10^6 to $<10^9\Omega$. See Table 3, #2 for alternative verification methods.

7.2.4.1.3 When conductive surfaces must be used as an ESD work surface, control methods to prevent an ESD event shall be documented by the ESD Control Program Plan.

Note: Conductive surfaces, grounded or ungrounded, can enable ESD events to occur.



Clarified Technical Requirements

7.2.4.1 Work Surfaces

Work surfaces in EPAs are those that will be used to physically host the ESDS item and may be used as a ground path for items that can be grounded but do not contain a Groundable Point (Gp). The work surface shall meet the following requirements:

7.2.4.1.1 The resistance of work surface where ESDS items are handled shall be in the dissipative range, from 10^6 to $<10^9\Omega$. See Table 3, #1 for alternative verification methods.

Note: This should be measured between two points 10" apart on the Work Surface and 2" from the edge in the commonly used area.

7.2.4.1.2 The resistance from the center of the work surface to the common point ground shall be 10^6 to $<10^9\Omega$. See Table 3, #2 for alternative verification methods.

7.2.4.1.3 When conductive surfaces must be used as an ESD work surface, control methods to prevent an ESD event shall be documented by the ESD Control Program Plan.

Note: Conductive surfaces, grounded or ungrounded, can enable ESD events to occur.



#	ESD Control	Verification Values (Alternate Test Methods)	Recommended Verification Intervals				
			Continuous	Daily	Monthly	Biannual	Annual
1	Work Surface Resistance	10^6 to $< 10^9\Omega$ (ANSI/ESD S4.1)			×		
2	Work Surface Grounding	10^6 to $< 10^9\Omega$ (ANSI/ESD S4.1)			×		
3	Protective Floor Resistance	If Dissipative: 10^6 to $< 10^9\Omega$ (ANSI/ESD S7.1) If Conductive: $< 10^6\Omega$ (ANSI/ESD S7.1)			×		
4	Protective Floor Grounding	If Dissipative: 10^6 to $< 10^9\Omega$ (ANSI/ESD S7.1) If Conductive: $< 1\Omega$ (ANSI/ESD S7.1)			×		
5	Wrist Strap Check	Go/No Go functional check	×				
6	Wrist Strap Resistance range	From $800k\Omega$ to $1.2M\Omega$ <i>per ANSI/ESD S20.20-2014</i> (ANSI/ESD S1.1)			×		
7	Wrist Strap Ground Point Resistance	$< 1\Omega$ or $< 1.2 \times 10^6\Omega$ if measured through a CMS			×		
8	Foot Grounding Device Integrity	$< 3.5 \times 10^7\Omega$ (ANSI/ESD STM97.1)		×			
9	ESD CMS	Calibration is required					×
10	Stool / Chair Grounding	10^6 to $< 10^9\Omega$ (ANSI/ESD S12.1)				×	



ESD Control Plan Requirements Tailoring

7.2.1 General ESD Control Program Plan Requirements

7.2.1.1 The baseline ESD Control Program Plan shall be fully traceable to ANSI/ESD S20.20-2014 and the requirements herein.

7.2.1.2 Tailoring is permitted, as the requirements in Section 7 of this document may not be applicable in all situations. Tailoring is accomplished by evaluating the applicability of, or the risk of not implementing, a requirement for a specific application or scenario (e.g., mission class, R&D project, facility limitations, etc.). Upon completion of the evaluation, requirements may be deleted or modified outside the limits of this standard for technical or logistical reasons with ESD Control Program Manager approval. Tailoring decisions shall be documented in the ESD Control Program Plan and include rationale, risk assessments, and technical justifications.

ESD Control Plan Requirements

7.2.3 Baseline ESD Control Program Plan Requirements

7.2.3.1 The Certification, Recertification, and Compliance Verification Plan requirements of ANSI/ESD S20.20-2014 apply with the following additions and modifications:

7.2.3.1.1 The ESD Control Program Plan shall define the baseline sensitivity level addressed by the EPA requirements (e.g., HBM 1A) as well as any other EPA sensitivity levels considered to be within the scope of the plan (e.g., HBM 1B, HBM 0, CDM C1).

7.2.3.1.2 The ESD Control Program Plan shall define the criteria for when ESDS hardware is to be handled within a certified EPA (e.g., mission risk class, R&D status, commercial off-the-shelf ground support equipment, etc.).

7.2.3.1.3 All EPA certifications shall be performed by the ESD Control Program Manager, or their representative.

Certified ESD Control Program Manager

7.2.2.1 Personnel Training and Certification

7.2.2.1.1 The ESD Control Program Manager shall have formal training in:

- (a) the technical requirements in Chapter 8 of ANSI/ESD S20.20-2014
- (b) static charge prevention and mitigation methods for operators and EPAs
- (c) processes for certification and verification of ESD control materials and ESD protected areas

Note: ESDA, iNARTE, or other third-party ANSI/ESD S20.20 training courses are recommended to meet this requirement. This may also be accomplished via documented on-the-job training.

The ANSI/ESD S20.20

ANSI/ESD S20.20-2014

CAUTION NOTICE

Electrostatic Discharge Association (ESDA) standards and publications are designed to serve the public interest by eliminating misunderstandings between manufacturers and purchasers, facilitating the interchangeability and improvement of products and assisting the purchaser in selecting and obtaining the proper product for his particular needs. The existence of such standards and publications shall not in any respect preclude any member or non-member of the Association from manufacturing or selling products not conforming to such standards and publications. Nor shall the fact that a standard or publication is published by the Association preclude its voluntary use by non-members of the Association, whether the document is to be used either domestically or internationally. Recommended standards and publications are adopted by the ESDA in accordance with the ANSI Patent policy.

Interpretation of ESDA Standards: The interpretation of standards in-so-far as it may relate to a specific product or manufacturer is a proper matter for the individual company concerned and cannot be undertaken by any person acting for the ESDA. The ESDA Standards Chairman may make comments limited to an explanation or clarification of the technical language or provisions in a standard, but not related to its application to specific products and manufacturers. No other person is authorized to comment on behalf of the ESDA on any ESDA Standard.

Office of Safety and Mission Assurance



ANSI/ESD S20.20 Requirements

6.2 ESD Control Program Manager or Coordinator

An ESD Control Program Manager or Coordinator shall be assigned by the Organization to verify the compliance of the Program in accordance with the requirements of this document.

7.1 ESD Control Program Plan

The Organization shall prepare an ESD Control Program Plan that addresses each of the requirements of the Program. Those requirements include:

- Training
- Product Qualification
- Compliance Verification
- Grounding / Equipotential Bonding Systems
- Personnel Grounding
- ESD Protected Area (EPA) Requirements
- Packaging Systems
- Marking



Conclusion

- The update to the NASA STD-8739.6 includes:
 - Reorganization of training requirements
 - Adoption of most recent revisions of J-STD001GS and IPC/WHMA-A-620C-S
 - Re-addition of denatured ethyl alcohol as a standard solvent
 - Administrative and technical ESD requirements to supplement ANSI/ESD S20.20 and clarify commonly misunderstood requirements



Questions

